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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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EXAMINER	
PETERSON, CHRISTOPHER K	

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2622	

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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/603,729	YAMAMOTO, KATSUMI	
	Examiner	Art Unit	
	CHRISTOPHER K. PETERSON	2622	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *28 March 2011*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-5,7-12,14,15 and 17-19* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-5,7-12,14,15 and 17-19* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)

2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.

4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .

5) ☐ Notice of Informal Patent Application

6) ☐ Other: _____.

Response to Arguments

1. Applicant's arguments with respect to claim 1, 8, and 15 have been considered but are moot in view of the new ground(s) of rejection.

Claim Rejections - 35 USC § 103

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

2. Claims 1 - 3, 7 - 10, 14, and are rejected under 35 U.S.C. 103(a) as being unpatentable over Tan et al. (U.S. Pat. 6,043,481) in view of Assadi et al. (U.S. Pat. 6,166,369), further in view of Chang (US Pat. Pub. # 2004/0147105), and further in view of Uchiyama (US Patent # 6,621,637).

First, regarding **claim 1**, the Tan reference teaches an image sensor comprising: a plurality of pixels formed in a semiconductor substrate (substrate 12), each pixel including a light sensitive element (optoelectronic elements 14), a micro-lens (micro-lens element 18) over each of the light sensitive elements, and a layer (transmissive layer member 16) disposed between the light sensitive elements (optoelectronic elements 14) and the micro- lenses (18), wherein the layer (16) of includes raised ridge structures (ridge elements 19) formed from the layer (16) surrounding each of said micro-lenses (18), wherein each said raised ridge structure (19) at least partially

supports the micro-lens (as shown in Fig. 9b), wherein the micro-lens (18) overlays a base portion of the raised ridge structure (19). Please refer to Figs. 4 and 9b, and Col. 3, Lines 35 - Col. 4, Lines 10. Tan teaches a light transmissive layer member 16 or spacer member of transmissive polymer or dielectric material, such choice of material including glass, covers the substrate 12 and optoelectronic elements 14 therein (Col. 3, lines 37 - 41).

What the Tan reference fails to specifically teach is that the raised ridge structure has a triangular cross-section. However, the Assadi reference illustrates in Fig. 3 and discloses in Col. 2, Lines 5-8 and Lines 26-48 an image sensor comprising a raised ridge structure (reflective structure 12) having a triangular cross-section surrounding a micro-lens (micro-lens 24) over a photosensitive device (20). It would have been obvious to one of ordinary skill in the art at the time the invention was made to have included the raised ridge structure having a triangular cross-section, as taught by Assadi, with the image sensor of Tan. One would have been motivated to do so because as Assadi teaches in Col. 2, Lines 42-51, having a raised ridge structure with a reflective triangular cross-section allows more light to be reflected to the micro-lens for diffraction towards the photosensitive device, thereby improving the fill factor of the photosensitive device.

What the Tan in view of Assadi references fail to specifically teach is that the layer is made of oxide. However, the Chang reference illustrates in Figs. 7 - 9 and discloses in Para 47 - 59 the spacer layer 22 is preferably formed from a spacer material selected from the group including but not limited to silicon oxide materials,

silicon nitride materials, silicon oxynitride materials (Para 50). It would have been obvious to one of ordinary skill in the art at the time the invention was made to have included the oxide layer as taught by Chang, with the image sensor of Tan in view of Assadi. One would have been motivated to do so because as Chang teaches in Para 50, the spacer layer 22 is preferably formed of a material which is intended to separate a series of patterned microlens layers from the color filter layer 20.

What the Tan in view of Assadi and further in view of Change references fail to specifically teach a maximum width of the micro-lens is greater than a width of the micro-lens at the horizontal top surface of the layer of oxide. However, the Uchiyama reference illustrates in Figs. 1 - 3 a maximum width (width of lines 201) of the micro-lens (lens members 105)is greater than a width of the micro-lens (105) at the horizontal top surface (light-transmissive substrate 101). Uchiyama (Fig. 2) teaches it is preferable to make the top side width 203 as small as possible. On the other hand, when a bottom side width 204 of the light-absorption material 102 is made as large as possible (Col. 8, lines 26 - 37). By this definition the light-absorption material 102 of Uchiyama would provide a maximum width of the lens members 105 and the width. Applicant's Specification does not specifically teach the limitation "a maximum width of the micro-lens is greater than a width of the micro-lens at the horizontal top surface of the layer of oxide", but in Figure 8 of the specification one skilled in the art would see that a raised ridge structure formed in a triangle shape would meet this definition. It would have been obvious to one of ordinary skill in the art at the time the invention was made to have included the light-absorption material and lens element as taught by Uchiyama, with the

image sensor of Tan in view of Assadi and further in view of Chang. One would have been motivated to do so because as Uchiyama teaches in Col. 4, lines 11 - 27, to provide a transmissive screen which provides excellent resolution and which does not have reduced image quality due to moiré.

Next, considering **claim 2**, the Tan reference teaches the limitations above, and while Tan does teach that a raised ridge structure (19) is located around the periphery of each micro-lens (18), Tan does not specifically disclose that the raised ridge structure is circular. However, the Assadi reference does teach a raised ridge structure (reflective surfaces 12) that surrounds each micro-lens and circularly arranged around each photosensitive device (20) (See Col. 2, Lines 26-48 and Fig. 3).

As for **claim 3**, again the limitations of claim 1 are taught above, and the Tan reference illustrates in Figs. 4 and 9b that the raised ridge structure (19) confines the micro-lens (18).

As for **claim 7**, Chang teaches a color filter layer (color filter layer 20) between the micro-lenses (microlens layer 24) and the light sensitive elements (photoactive regions 12a, 12b and 12c) (Para 49).

In regard to **claim 8**, as is similarly disclosed above with respect to claim 1, the Tan reference teaches pixel of an image sensor comprising a light sensitive element (optoelectronic elements 14) formed in a semiconductor substrate (substrate 12), a micro-lens (micro-lens element 18) over the light sensitive element, and a layer (transmissive layer member 16) disposed between the light sensitive elements (optoelectronic elements 14) and the micro- lenses (18), wherein the layer (16) of

includes raised ridge structures (ridge elements 19) formed from the layer (16) surrounding each of said micro-lenses (18), wherein said raised ridge structure (19) at least partially supports the micro-lens (as shown in Fig. 9b), wherein the micro-lens (18) overlays a base portion of the raised ridge structure (19). Please refer to Figs. 4 and 9b, and Col. 3, Lines 35 - Col. 4, Lines 10. Tan teaches a light transmissive layer member 16 or spacer member of transmissive polymer or dielectric material, such choice of material including glass, covers the substrate 12 and optoelectronic elements 14 therein (Col. 3, lines 37 - 41). What the Tan reference fails to specifically teach is that the raised ridge structure has a triangular cross-section. However, the Assadi reference illustrates in Fig. 3 and discloses in Col. 2, Lines 5-8 and Lines 26-48 an image sensor comprising a raised ridge structure (reflective structure 12) having a triangular cross-section surrounding a micro-lens (micro-lens 24) over a photosensitive device (20). It would have been obvious to one of ordinary skill in the art at the time the invention was made to have included the raised ridge structure having a triangular cross-section, as taught by Assadi, with the image sensor of Tan. One would have been motivated to do so because as Assadi teaches in Col. 2, Lines 42-51, having a raised ridge structure with a reflective triangular cross-section allows more light to be reflected to the micro-lens for diffraction towards the photosensitive device, thereby improving the fill factor of the photosensitive device.

What the Tan in view of Assadi references fail to specifically teach is that the layer is made of oxide. However, the Chang reference illustrates in Figs. 7 - 9 and discloses in Para 47 - 59 the spacer layer 22 is preferably formed from a spacer

material selected from the group including but not limited to silicon oxide materials, silicon nitride materials, silicon oxynitride materials (Para 50). It would have been obvious to one of ordinary skill in the art at the time the invention was made to have included the oxide layer as taught by Chang, with the image sensor of Tan in view of Assadi. One would have been motivated to do so because as Chang teaches in Para 50, the spacer layer 22 is preferably formed of a material which is intended to separate a series of patterned microlens layers from the color filter layer 20.

What the Tan in view of Assadi and further in view of Change references fail to specifically teach a maximum width of the micro-lens is greater than a width of the micro-lens at the horizontal top surface of the layer of oxide. However, the Uchiyama reference illustrates in Figs. 1 - 3 a maximum width (width of lines 201) of the micro-lens (lens members 105)is greater than a width of the micro-lens (105) at the horizontal top surface (light-transmissive substrate 101). Uchiyama (Fig. 2) teaches it is preferable to make the top side width 203 as small as possible. On the other hand, when a bottom side width 204 of the light-absorption material 102 is made as large as possible (Col. 8, lines 26 - 37). By this definition the light-absorption material 102 of Uchiyama would provide a maximum width of the lens members 105 and the width. Applicant's Specification does not specifically teach the limitation "a maximum width of the micro-lens is greater than a width of the micro-lens at the horizontal top surface of the layer of oxide", but in Figure 8 of the specification one skilled in the art would see that a raised ridge structure formed in a triangle shape would meet this definition. It would have been obvious to one of ordinary skill in the art at the time the invention was made to have

included the light-absorption material and lens element as taught by Uchiyama, with the image sensor of Tan in view of Assadi and further in view of Chang. One would have been motivated to do so because as Uchiyama teaches in Col. 4, lines 11 - 27, to provide a transmissive screen which provides excellent resolution and which does not have reduced image quality due to moiré.

In regard to **claim 9**, Tan in view of Assadi teaches the limitations of claim 8 above, and while Tan does teach that a raised ridge structure (19) is located around the periphery of each micro-lens (18), Tan does not specifically disclose that the raised ridge structure is circular. However, the Assadi reference does teach a raised ridge structure (reflective surfaces 12) that surrounds each micro-lens and circularly arranged around each photosensitive device (20) (See Col. 2, Lines 26-48 and Fig. 3).

Regarding **claim 10**, again the limitations of claim 8 are taught above, and the Tan reference illustrates in Figs. 4 and 9b that the raised ridge structure (19) confines the micro-lens (18).

In regard to **claim 14**, Chang teaches a color filter layer (color filter layer 20) between the micro-lenses (microlens layer 24) and the light sensitive elements (photoactive regions 12a, 12b and 12c) (Para 49).

3. Claims 4 and 11 are rejected under 35 U.S.C. 103(a) as being unpatentable over Tan et al. (U.S. Pat. 6,043,481) in view of Assadi et al. (U.S. Pat. 6,166,369), further in view of Chang (US Pat. Pub. # 2004/0147105), further in view of

Uchiyama (US Patent # 6,621,637), and further in view of Applicant's admitted prior art.

In regard to **claims 4 and 11**, the limitations of claims 1 and 8 are respectively taught above, but Tan in view of Assadi does not specifically disclose that the micro-lenses are formed from polymethylmethacrylate or polyglycidylmethacrylate. However, noting Para. [0025] of the Applicant's current specification, the Applicant discloses that the use of acrylics such as polymethylmethacrylate or polyglycidylmethacrylate is common in forming micro-lenses. Thus, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have formed the micro-lenses of Tan in view of Assadi using polymethylmethacrylate or polyglycidylmethacrylate. One would have been motivated to do so because the use of common materials reduces manufacturing costs and the need for additional specialized manufacturing equipment.

4. Claims 5 and 12 are rejected under 35 U.S.C. 103(a) as being unpatentable over Tan et al. (U.S. Pat. 6,043,481) in view of Assadi et al. (U.S. Pat. 6,166,369), further in view of Chang (US Pat. Pub. # 2004/0147105), further in view of Uchiyama (US Patent # 6,621,637), and further in view of Nakai (U.S. Pat. 5,396,090).

Next, considering **claim 5**, the limitations of claim 1 are taught above by Tan in view of Assadi, but the combination fails to specifically disclose that the raised ridge structures have a height of about 0.2 microns. However, the Nakai reference teaches an image sensor having a plurality of micro-lenses (66) surrounded by a raised ridge

structure (partition wall 51), wherein the partition wall 51 can have a height of 0.2 microns, as taught in Figs. 1 and 5, and Col. 4, Line 46 - Col. 5, Line 50. It would have been obvious to one of ordinary skill in the art at the time the invention was made to have incorporated the raised ridge structure having a height of 0.2 microns, as taught by Nakai, with the raised ridge structure of Tan in view of Assadi. One would have been motivated to do so because by limiting the height of the raised ridge structure, the dimensions of the image sensor can remain small, therefore allowing for use in compact imaging devices.

Regarding **claim 12**, the limitations of claim 8 are taught above, but Tan in view of Assadi fails to specifically disclose that the raised ridge structures have a height of about 0.2 microns. However, the Nakai reference teaches an image sensor having a plurality of micro-lenses (66) surrounded by a raised ridge structure (partition wall 51), wherein the partition wall 51 can have a height of 0.2 microns, as taught in Figs. 1 and 5, and Col. 4, Line 46 - Col. 5, Line 50.

5. Claims 15 and 17 - 19 are rejected under 35 U.S.C. 103(a) as being unpatentable over Tan et al. (U.S. Pat. 6,043,481) in view of Assadi et al. (U.S. Pat. 6,166,369), further in view of Chang (US Pat. Pub. # 2004/0147105), further in view of Uchiyama (US Patent # 6,621,637), and further in view of Engelhardt et al. (U.S. Pat. 6,387,773).

Regarding **claim 15**, Fig. 9B and Col. 5, Lines 20-38 of the Tan reference teaches a method of forming a pixel of an image sensor comprising forming a light

sensitive element (14) in a semiconductor substrate (12), said raised ridge structure (19) encompassing said light sensitive element (14); and forming a micro-lens (18) within the interior of the raised ridge structure and over the light sensitive element, wherein the raised ridge structure at least partially supports the micro-lens, and further wherein the micro-lens (18) overlays a base portion of the raised ridge structure, as such an overlay is inherent in the reflow process of forming the micro-lens (18) between the ridge elements (19). What the Tan reference fails to specifically teach is that the raised ridge structure has a triangular cross-section, and that the top planarizing layer is isotropically etched to form the raised ridge structure and the top planarizing layer is oxide. However, as illustrated in Fig. 3 and disclosed in Col. 2, Lines 5-8, Col. 2, Lines 26-48, and Col. 2, Line 54 - Col. 3, Line 43, the Assadi reference teaches an image sensor comprising a raised ridge structure (reflective structure 12) that is formed by isotropically etching the top planarizing layer (i.e. chemically removing portions of the top planarizing layer in both directions), wherein the raised ridge structure has a triangular cross-section surrounding a micro-lens (micro-lens 24) over a photosensitive device (20). It would have been obvious to one of ordinary skill in the art at the time the invention was made to have included the raised ridge structure having a triangular cross-section, as taught by Assadi, with the image sensor of Tan. One would have been motivated to do so because as Assadi teaches in Col. 2, Lines 42-51, having a raised ridge structure with a reflective triangular cross- section allows more light to be reflected to the micro-lens for diffraction towards the photosensitive device, thereby improving the fill factor of the photosensitive device.

What the Tan in view of Assadi references fail to specifically teach is that the layer is made of oxide. However, the Chang reference illustrates in Figs. 7 - 9 and discloses in Para 47 - 59 the spacer layer 22 is preferably formed from a spacer material selected from the group including but not limited to silicon oxide materials, silicon nitride materials, silicon oxynitride materials (Para 50). It would have been obvious to one of ordinary skill in the art at the time the invention was made to have included the oxide layer as taught by Chang, with the image sensor of Tan in view of Assadi. One would have been motivated to do so because as Chang teaches in Para 50, the spacer layer 22 is preferably formed of a material which is intended to separate a series of patterned microlens layers from the color filter layer 20.

What the Tan in view of Assadi and further in view of Chang references fail to specifically teach is an isotropically dry etching process. However, the Engelhardt reference illustrates in Fig. 1 and discloses in Col. 4, lines 23 – 49 an oxide can be grown thermally and subsequently etched away again wet-chemically or isotropically by dry etching. It would have been obvious to one of ordinary skill in the art at the time the invention was made to have included isotropically dry etching as taught by Engelhardt, with the image sensor of Tan in view of Assadi and further in view of Chang. One would have been motivated to do so because as Engelhardt teaches in Col. 2, lines 39 - 43), to provided a method which further comprises setting radio frequency power, pressure, magnetic field strength and/or process gas as a process parameter of the etching step to set the ratio of isotropic to anisotropic etching component.

What the Tan in view of Assadi and further in view of Change references fail to specifically teach a maximum width of the micro-lens is greater than a width of the micro-lens at the horizontal top surface of the layer of oxide. However, the Uchiyama reference illustrates in Figs. 1 - 3 a maximum width (width of lines 201) of the micro-lens (lens members 105)is greater than a width of the micro-lens (105) at the horizontal top surface (light-transmissive substrate 101). Uchiyama (Fig. 2) teaches it is preferable to make the top side width 203 as small as possible. On the other hand, when a bottom side width 204 of the light-absorption material 102 is made as large as possible (Col. 8, lines 26 - 37). By this definition the light-absorption material 102 of Uchiyama would provide a maximum width of the lens members 105 and the width. Applicant's Specification does not specifically teach the limitation "a maximum width of the micro-lens is greater than a width of the micro-lens at the horizontal top surface of the layer of oxide", but in Figure 8 of the specification one skilled in the art would see that a raised ridge structure formed in a triangle shape would meet this definition. It would have been obvious to one of ordinary skill in the art at the time the invention was made to have included the light-absorption material and lens element as taught by Uchiyama, with the image sensor of Tan in view of Assadi and further in view of Chang. One would have been motivated to do so because as Uchiyama teaches in Col. 4, lines 11 - 27, to provide a transmissive screen which provides excellent resolution and which does not have reduced image quality due to moiré.

In regard to **claim 16**, the limitations of claim 15 are taught above, and Tan further discloses that tile raised ridge structure (19) is formed in the top planarizing layer (16). Please refer to Figs. 4 and 9B, and Col. 3, Lines 41-45.

Next, considering **claim 17**, the limitations of claim 15 are set forth above, and the Tan reference illustrates in Figs. 4 and 9b that the raised ridge structure (19) confines the micro-lens (18).

As for **claim 18**, again the limitations of claim 15 are taught above, but Tan does not specifically teach that the raised ridge structure is a closed shape. However, as is illustrated in Fig. 2 and taught in Col. 2, Lines 30-34, the Assadi reference discloses that the raised ridge structure is a closed shape (e.g. a circle or orthogonal pattern).

Finally, considering **claim 19**, Chang teaches a color filter layer (color filter layer 20) between the micro-lenses (microlens layer 24) and the light sensitive elements (photoactive regions 12a, 12b and 12c) (Para 49).

Conclusion

6. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not

mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to CHRISTOPHER K. PETERSON whose telephone number is (571)270-1704. The examiner can normally be reached on Monday - Friday 6:30 - 4:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Sinh Tran can be reached on (571)272-7564. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/C. K. P./
Examiner, Art Unit 2622
4/25/2011

/Sinh Tran/
Supervisory Patent Examiner, Art Unit 2622